

#193

IMP-G

COUNT RATE DATA

69-053A-00E 8 TAPES  
69-053A-03A 13 TAPES  
69-053A-03B 20 TAPES  
69-053A-03C 4 TAPES

IMP-G

RATES FOR ALL NONOVERLAP SEQUENCE

69-053A-03A

This data set has been restored. There were originally 13 7-track, 800 BPI tapes written in Binary. There are two restored tapes. The DR tapes are 3480 cartridges and the DS tapes are 9-track, 6250 BPI. The original tapes were created on a 930 computer and the restored tapes were created on an IBM 9021 computer. The DR and DS numbers along with the corresponding D numbers are as follows:

DR#	DS#	D#	FILES	TIME SPAN
-----	-----	-----	-----	-----
DR004681	DS004681	D006950	1 - 30	06/21/69 - 09/29/69
		D006949	31 - 60	09/30/69 - 01/09/70
		D006951	61 - 90	01/09/70 - 04/20/70
		D006952	91 - 120	04/20/70 - 07/30/70
		D011906	121 - 150	07/30/70 - 11/07/70
		D011907	151 - 180	11/07/70 - 02/16/71
		D011908	181 - 210	02/16/71 - 05/28/71
DR004682	DS004682	D011909	1 - 30	05/28/71 - 09/06/71
		D018353	31 - 52	09/06/71 - 12/16/71
		D018354	53 - 82	12/16/71 - 01/16/72
		D018355	83 - 112	01/16/72 - 04/26/72
		D018356	113 - 142	04/28/72 - 08/04/72
		D018357	143 - 163	08/04/72 - 10/14/72

REQ. AGENT  
PAR  
ROP  
MAW

RAND NO.  
RB8610  
RC3474

ACQ. AGENT  
JJB

IMP-G

COUNT RATE DATA

69-053A-00E

69-053A-03A, 3B & 3C

This data set catalog contains IMP-G Rate Packed (RAPT), Pulse Height Analysis Event (PHAEST), Rate Summary (RAST), and Orbit Parameter (ORPT) data. The tapes are 800 BPI, 7-track, binary (with the exception of the Rate Summary data which is BCD). They were created on an XDS 930 computer.

The record size and number of files on each of the tapes in each data set can be found on table 17 in the following supplement from the University of Chicago.

The time spans for the tapes are:

Orbit Parameter Data (ORPT) 69-053A-00E

<u>D#</u>	<u>C#</u>	<u>TIME SPAN</u>
D-06946	C-08126	6/21/69 - 11/16/69
D-06947	C-08127	11/16/69 - 4/20/70
D-06948	C-08128	4/20/70 - 9/08/70
D-11931	C-09378	2/03/71 - 7/01/71
D-11930	C-09321	7/01/71 - 11/15/71
D-18350	C-15439	12/12/71 - 4/22/72
D-18351	C-15440	4/22/72 - 9/17/72
D-18352	C-15441	9/17/72 - 12/23/72

Rate Packed Data (RAPT) 69-053A-03A

D-06949	C-08129	9/30/69 - 1/09/70
D-06950	C-08130	6/21/69 - 9/29/69

<u>D#</u>	<u>C#</u>	<u>TIME SPAN</u>
D-06951	C-08131	1/09/70 - 4/20/70
D-06952	C-08132	4/20/70 - 7/30/70
D-11906	C-09322	7/30/70 - 11/07/70
D-11907	C-09323	11/07/70 - 2/16/71
D-11908	C-09324	2/16/71 - 5/28/71
D-11909	C-09325	5/28/71 - 9/06/71
D-18353	C-15442	9/06/71 - 12/16/71
D-18354	C-15443	12/16/71 - 1/16/72
D-18355	C-15444	1/16/72 - 4/26/72
D-18356	C-15445	4/28/72 - 8/04/72
D-18357	C-15446	8/04/72 - 10/14/72

Pulse Height Analysis Event Data (PHAEST) 69-053A-03B

D-06940	C-08120	8/27/69 - 11/02/69
D-06941	C-08121	6/21/69 - 8/27/69
D-06942	C-08122	11/02/69 - 1/09/70
D-06943	C-08123	1/09/70 - 3/17/70
D-06944	C-08124	3/17/70 - 5/23/70
D-06945	C-08125	5/23/70 - 7/30/70
D-11900	C-09379	7/30/70 - 10/04/70
D-11901	C-09380	10/04/70 - 12/10/70
D-11902	C-09381	12/11/70 - 2/16/71
D-11903	C-09382	2/16/71 - 4/25/71
D-11904	C-09383	4/25/71 - 7/01/71
D-11905	C-09384	7/01/71 - 9/05/71
D-18358	C-15447	9/06/71 - 11/12/71
D-18359	C-15448	11/12/71 - 1/18/72
D-18360	C-15449	1/18/72 - 3/26/72
D-18361	C-15450	3/26/72 - 6/01/72

<u>D#</u>	<u>C#</u>	<u>TIME SPAN</u>
D-18362	C-15451	6/01/72 - 8/07/72
D-18363	C-15452	8/07/72 - 10/13/72
D-18264	C-15453	10/13/72 - 12/20/72
D-18365	C-15454	12/20/72 - 12/23/72

Rate Summary Data (RAST) 69-053A-03C

D-06939	C-08119	6/21/69 - 5/23/70
D-11910	C-09377	5/23/70 - 4/25/71
D-18366	C-15455	4/25/71 - 3/26/72
D-18367	C-15456	3/26/72 - 12/23/72

Formula Used to Determine Day and year for Explorer 34.

A data card that was read in by the program(s) contain the start day of the orbit (144) for the year 1967.

In the program when the PSC\* is calculated the following check was used.

1. When the PSC\* is 0 to 221 the calculation was:  
 $PSC^* + 144$  which had the day count of 144 to 365  
for the year 1967.
2. When the PSC\* is 222 to 587 the calculation was:  
 $PSC^* + 144 - 365$  which had the day count of 1 to  
366 for the year 1968.
3. When the PSC\* is 588 and greater the calculation was:  
 $PSC^* + 144 - 731$  which had the day count of 1 and up to  
the final day on the input tapes for the year 1968.

---

\*PSC = PSEUDO SEQUENCE COUNT

## SEQUENCE COUNT FORMULA

Use Sequence Count in data format to obtain data and time of measurement (start time of first orbit corresponds to sequence count 44,651, L.E., Day 144 (May 24, 1967) at 14:26.1 UT). Each sequence was 20.45439 Sec. Long. Experimenter says time span of data is 5/3/69.

Total number of Intervals on sequence count minus intervals at launch on sequence count equals intervals since launch on sequence count.

Intervals since launch on sequence count times 20.45439 Sec/intervals equals sec. from launch.

Sec. From launch divided by NO. Of Sec. in a day equals days from launch.

### EXAMPLE

2238356      Sequence Count  
- 44651      Sequence Count at launch (base)  
2193705      Sequence Interval since launch

2193705      Sequence Interval since launch  
x20.45439      Sec long per interval  
44870897.61495      Sec from launch  
44870897.61495 -- 86400 sec. in day = 519.33909 Days since launch

Satellite	T BASE				PSC BASE	R TIME/SEQ (seconds)
	Day	Hr.	Min.	Year		
IMP-A	331	4	10.2	1963	96	81.91697
IMP-B Orbits (1 to 90)	278	3	59.7	1964	39	81.84857
IMP-B Orbits (91 to 124)	62	13	40.2	1965	158807	81.84356
IMP-C	149	12	41.5	1965	50	81.91890
IMP-F	144	14	26.1	1967	44651	20.45437
IMP-G	172	9	28.1	1969	28464	20.454764

*Added to documentation from TRF  
surplus, Discard if its in the way.  
NJS 6/18/87*

B07525  
MAR 30 1971

IMP

HCK: T

Data Formats for Library Magnetic Tapes and Microfilm from  
The University of Chicago Charged Particle Experiments on  
the Satellites IMP-4 and IMP-5\*

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1. Introduction

We are submitting to the NSSDC the final processed data obtained from the University of Chicago instruments on the eccentric polar orbiting satellites IMP-4 and IMP-5. IMP-4 data coverage is from the launch date of May 24, 1967 through April 29, 1969. IMP-5 data coverage is from the launch date of June 21, 1969, and continues until the present time (March, 1971). These data are presented on microfilm and on magnetic tape. On microfilm are time-intensity plots for the averaged counting rates with each plot corresponding to a Bartel's Solar Rotation. There are four categories of magnetic tape:

- 1) Averaged counting rates,
- 2) Raw accumulator readouts,
- 3) Pulse height analysis readouts, and
- 4) Orbit parameters.

This document describes the instruments, the formats of the data and the relationship between the data and the physical parameters the instruments were recording. A reference list of scientific publications by the University of Chicago group based on the IMP-4 and IMP-5 data is attached.

2. Instrumentation and Performance

The University of Chicago instruments on the satellites IMP-4 and IMP-5 are sufficiently similar that their characteristics can be described in parallel. The performance of the IMP-5 instrument will be reported when the data are submitted.

2.1 General Description

The University of Chicago instrument occupies one whole facet of the right octagonal cylinder of the IMP-4 (5) main body. Figures

1 and 2 show the location of the instruments and the orientation of the spacecrafts for IMP-4 and 5, respectively. The weight and power consumption of these instruments are listed in Table 1.

TABLE 1  
Instrument Weight and Power

	IMP-4	IMP-5
WEIGHT (lb)	9.3	10.8
POWER (Watt)	2.1	2.3

## 2.2 Detector array

The instrument on IMP-4 has two telescopes, a composition telescope and an electron telescope, whereas the instrument on IMP-5 has only a composition telescope.

### 2.2.1 IMP-4:

#### 2.2.1a Composition telescope:

A schematic of the composition telescope is shown in Figure

3. The anti-coincidence scintillation counter D6 and

detector D1 define a geometrical factor of  $1.6 \text{ cm}^2\text{-ster.}$

An aluminized mylar window protects the detectors from sunlight. The thickness of the telescope absorbers are tabulated in Table 2.

Composition Telescope Absorbers

Absorber name	IMP-4		IMP-5	
	THICKNESS (gm/cm <sup>2</sup> )	MATERIAL	THICKNESS (gm/cm <sup>2</sup> )	MATERIAL
Mylar Window	$1.24 \times 10^{-3}$	Aluminized Mylar	$1.24 \times 10^{-3}$	Aluminized Mylar
D <sub>1</sub> Depletion depth	$8.81 \times 10^{-2}$	Li-drifted Si	$9.47 \times 10^{-2}$	Li-drifted Si
Dead layer	$2.26 \times 10^{-2}$		$7.6 \times 10^{-3}$	
D <sub>1</sub> -D <sub>2</sub> shield	$5.2 \times 10^{-3}$	Titanium	$8.2 \times 10^{-3}$	Titanium
D <sub>2</sub> Dead layer	$3.19 \times 10^{-2}$	Li-drifted Si	$1.33 \times 10^{-2}$	Li-drifted Si
Depletion depth	$3.50 \times 10^{-1}$		$3.62 \times 10^{-1}$	
D <sub>3</sub> Depletion depth	$1.93 \times 10^{-1}$	Li-drifted Si	$1.97 \times 10^{-1}$	Li-drifted Si
Dead layer	$3.98 \times 10^{-2}$		$1.98 \times 10^{-2}$	
D <sub>4</sub> Housing	$2.21 \times 10^{-2}$	Magnesium	$2.21 \times 10^{-2}$	Magnesium
D <sub>4</sub>	$1.15 \times 10^1$	CsI (II)	$1.15 \times 10^1$	CsI (II)
D <sub>4</sub> -D <sub>5</sub> Housing	$1.55 \times 10^{-1}$	Magnesium	$1.77 \times 10^{-1}$	Magnesium
D <sub>5</sub>	$6.48 \times 10^{-1}$	Plastic	$5.72$	CsI (II)
D <sub>5</sub> -CK Housing		Not Applicable	$2.56 \times 10^{-1}$	Magnesium
Cherenkov detector		Not Applicable	$3.98$	Sapphire (RCA-8664 PM tube)

TABLE 2

### 2.2.1b Electron telescope:

A schematic of the electron telescope is shown in Figure 3. This range total-energy telescope comprises an aluminized mylar window and a windowless Li-drifted silicon detector. The  $44^{\circ}$  acceptance cone and geometrical factor of  $0.05 \text{ cm}^2 \text{ sr}$  are defined by an aluminum collimator which also serves as omni-directional shielding. The pertinent thicknesses are tabulated in Table 3.

TABLE 3

IMP-4 Electron Telescope Absorbers		
Absorber name	Thickness (gm/cm <sup>2</sup> )	Material
Mylar window	$1.24 \times 10^{-3}$	Aluminized Mylar
Detector Depletion depth Dead layer	0.3 0.03	Li-drifted Silicon
Omni-directional Shield	1.8	Aluminum

## 2.2.2 IMP-5

The IMP-5 composition telescope is shown schematically in Figure 4. The anti-coincidence scintillation counter D6 defines a geometrical factor of  $1.6 \text{ cm}^2 \cdot \text{sr}$  for the  $55^\circ$  opening cone, and a geometrical factor of  $1.1 \text{ cm}^2 \cdot \text{sr}$  for the  $36^\circ$  opening cone. An aluminized mylar window protects the detectors from sunlight. Absorber thicknesses are shown in Table 2.

## 2.3 Logic

Logic diagrams of the two instruments are shown in Figures 5 and 6 respectively. The logic of each instrument has two modes (c.f. tables 9 and 10):

- 1) Normal mode, and
- 2) Calibrate mode.

### 2.3.1 IMP-4:

#### 2.3.1a Composition Telescope

Normal Mode. Signals from all the detectors are utilized to give information concerning the flux of cosmic ray particles. This information is derived from six counting rates and three pulse-height analysis (PHA) readings from the composition telescope and two counting rates from the electron telescope. The eight counting rates and their readout frequencies are listed in Table 4.  $D1\overline{D2D6}$  is pre-scaled by 8 when the counting rate  $\gtrsim 22 \text{ KHz}$ ;  $D1D2\overline{D3D6}$  is pre-scaled by 128 when the counting rate  $\gtrsim 1.5 \text{ KHz}$ .

TABLE 4  
IMP-4 Counting Rates

Counting Rate	Readout Frequency
$D_{1H} \overline{D_2 D_6}$	Four times per sequence*
$D_{1H} \overline{D_2 D_3 D_6} = D_{1H} D_2 \overline{D_3 D_6}$	Twice per sequence
$D_{1H} D_2 D_3 D_4 \overline{D_5 D_6}$	"
$D_{1L} D_2 D_3 D_4 D_5 \overline{D_6} = D_{1L} D_2 D_3 D_4 \overline{D_5 L} \overline{D_6}$	"
$D_5$ (Analog count rate meter)	Once per sequence, 128 consecutive sequences every 1024 sequences
$D_6$ (Analog count rate meter)	Once per sequence, 896 consecutive sequences every 1024 sequences
$E_1$ (cf sec. 2.3.1b)	Once per sequence
$E_2$ (cf sec. 2.3.1b)	"

\*c.f. Sec. 2.4 for sequence time

Note: Settings of  $D_{1L}$ ,  $D_{1H}$ ,  $D_{5L}$  and  $D_{5H}$  are explained in 2.5.1a

During each frame (cf.sec. 2.4), one incident particle may be pulse-height analyzed and recorded together with its angular sector (AS) and range identification (ID) information. The three 256-channel pulse-height analyzers are assigned to detectors D1, D2 and D4 respectively. The angular sector information comes from the Optical Aspect package on the spacecraft and signifies an octant in a plane\* perpendicular to the spin axis in which the PHA occurred (see Figure 7). The range identification indicates the number of detectors the PHA event has triggered, i.e. a particle that penetrated D1 and D2 and stopped in D3 would be an ID = 3

\* Essentially the ecliptic.

event and correspondingly the PHA reading from D4 should be zero.

The definition of the ID's and the corresponding proton and electron energies are given in Table 5.

TABLE 5  
IMP-4 Composition Telescope Energy Ranges

ID	Definition	Proton Energy (MeV)	Electron Energy (MeV)*
0	Calibrate mode	--	--
1	D <sub>1H</sub> D <sub>2D6</sub>	0.78 - 9.55 (+ 0.07)	0.17 ~ 1.0
2	D <sub>1H</sub> D <sub>2D3D6</sub>	9.6 - 18.8 (+ 0.2)	0.75 ~ 1.6
3	D <sub>1H</sub> D <sub>2D3D4D6</sub>	18.8 - 29.5 (+ 0.7)	1.4 ~ 3.0
4	D <sub>1H</sub> D <sub>2D3D4D5D6</sub>	29.5 - 94.2 (+ 1.5)	14 ~ 45
5	D <sub>1L</sub> D <sub>2D3D4D5L</sub> D <sub>6</sub>	> 170 ± 10	≥ 40
6	D <sub>1L</sub> D <sub>2D3D4D5L</sub> D <sub>5H</sub> D <sub>6</sub>	94 - 170	--
7	Not defined	--	--

\* electron energies are approximate because of range straggling.

Not all ID's have an equal chance of being read out. When the stored PHA event is either an ID = 1 (D<sub>1D2D6</sub>) or ID = 5 or 6 (D<sub>1D2D3D4D5L</sub>D<sub>6</sub>), then prior to readout another PHA event may replace it. However, when the stored event is either an ID = 2 (D<sub>1D2D3D6</sub>), ID = 3 (D<sub>1D2D3D4D6</sub>) or ID = 4 (D<sub>1D2D3D4D5D6</sub>), the storage will be locked and no event may replace this event prior to readout. In other words, ID = 2, 3 and 4 type of events have priority over ID = 1, 5 and 6 events for storage and readout.

Calibrate Mode. When the instrument is in calibrate mode, the ID

is set to zero. For every 8192 sequences, there are 128 consecutive sequences of calibrate mode, during which: (1) all coincidence requirements for the counting rates are removed so that individual detector counting rates may be monitored, and (2) in the final three readouts of a sequence each of the three analyzers are calibrated with pulses of different fixed amplitudes to monitor possible gain-shifts in the system.

#### 2.3.1b Electron telescope

Normal Mode. The signal from the detector is analyzed with a two-channel pulse height analyzer and the counting rate of each channel is telemetered (cf. sec 2.4).

Table 6 summarizes energy ranges of this telescope and Table 4 the readout frequency.

TABLE 6  
IMP-4 Electron Telescope Energy Ranges

Designation	Electron Energy Interval (keV)	Proton* Energy Interval (keV)
E1	85 - 135	$\sim 750^+$
E2	160 - 370	$\sim 850^+$

\* For the detection of protons with energies  $> 32$  MeV, which penetrate the Al shielding, the effective omni-directional geometrical factor is  $0.2 \text{ cm}^2 \text{ sr}$ .

+ Collimated protons are counted only in a narrow energy band width ( $\sim 40$  keV) just above the window penetration energy.

Calibrate Mode. During calibrate mode the electron telescope is unaffected except that one pulse (count) is added to the E1 channel for the last three readouts of each calibrate sequence.

#### 2.3.2 IMP-5:

Normal Mode. Signals from all the detectors are utilized to give information concerning the flux of cosmic ray particles. This information is derived from six counting rates and three pulse-height analysis (PHA) readings. The counting rates and their readout frequencies are listed in Table 7.

TABLE 7  
IMP-5 Counting Rates

Counting Rate	Readout Frequency <sup>†</sup>
D1 <u>D2D6</u>	Four times per sequence*
D1D2 <u>D3D6</u>	Twice per sequence
D1D2 <u>D3D6</u> (prescaled by 128)	Once per sequence
D1D2D3D4 <u>D5L D6</u>	Twice per sequence
D2D3D4D5 <u>L CKD6</u>	Once per sequence
D2D3D4D5 <u>L CKD6</u>	Twice per sequence
D5 (Analog count rate meter)	Once per sequence, 128 consecutive sequences every 1024 sequences
D6 (Analog count rate meter)	Once per sequence, 896 consecutive sequences every 1024 sequences

<sup>†</sup> Nominal accumulation time for all but analog rates is 4.80 seconds immediately preceding readout.

\* IMP-5 Sequence time will be included in post launch performance report.

Note: Settings of D5<sub>L</sub> and D5<sub>H</sub> are explained in Sec. 2.5.2

The rate D1D2D6 is prescaled by 8 when this counting rate is  $\geq$  22 KHz. Accumulation periods when this prescaling is in effect are indicated by setting RR1 (cf. Table 10) to 1.

The rate D1D2D3D6 collected in accumulator 7b is prescaled by 128 whenever this rate is greater than  $\geq$  1.3 KHz. As there is no separate indication of whether the D1D2D3D6 rate is prescaled, this must be determined by comparing this rate with the permanently prescaled D1D2D3D6 rate, which

collects in accumulator 7a. The prescaling on the D1D2D3D6 (7a) rate is such that it collects the 1st count, then the 129th count, etc.

During the 4.8 seconds of each accumulation interval, one PHA event may be registered together with its angular sector (AS) and range identification (ID) information. The PHA comes from three pulse height analyzers: PHA1, 256 channels, assigned to D1 for ID = 0 to 5, and assigned to CK for ID = 6 and 7; PHA2, 512 channels, assigned to D2; PHA4, 256 channels, assigned to D4. The angular sector information comes from the Optical Aspect Sensor on the spacecraft and signifies an octant in the ecliptic\* plane in (cf. figure 7), which the PHA occurred. The range identification indicates the number of detectors the PHA event has triggered; i.e. a particle that penetrated D1 and D2 and stopped in D3 would be an ID = 3 event, and correspondingly the PHA reading from D4 should be zero. The definition of the IDs and the corresponding proton energies are given in Table 8.

\* Actually in a plane perpendicular to the spacecraft spin axis which is approximately normal to the ecliptic plane.

TABLE 8  
IMP-5 Energy Ranges

ID	Definition	Proton Energy (MeV)
0*	Calibrate mode, analyze D1, D2, D4	
1	D1D2D6	0.78 - 8.45 (+ 0.25)
2	D1D2D3D6	8.45 - 18.7 (+ 0.3)
3	D1D2D3D4D6	18.7 - 30.9 (+ 2)
4	D1D2D3D4D5 <sub>L</sub> D6	30.9 - 94.8 (+ 1)
5	D1D2D3D4D5 <sub>L</sub> CKD6	94.8 - 119 <sup>+</sup>
6	D1D2D3D4D5 <sub>L</sub> CKD6	> 119
7	Calibrate mode, analyze CK, D2, D4	

+ Since some particle trajectories pass through the D5, but do not hit CK (see Figure 4), ID5 events include a percentage of particles with energies > 119 MeV.  
\*Also see 2.5.2a.

Not all events have an equal chance of being readout. If an event satisfies the condition D1D2D6 (D5<sub>L</sub> + D5<sub>H</sub>), the analysis gates are locked (high priority event) and no other event will be analyzed during the accumulation period in progress. If this priority condition is not met (low priority event), each succeeding event will be analyzed until the end of the accumulation period. Thus, ID = 1 events are low priority; ID = 2, 3 or 4 events are high priority; ID = 5 or 6 events may be high or low priority (cf. sec. 2.5.2a).

Calibrate Mode. When the instrument is in calibrate mode, the

ID is 0 or 7. For every 8192 sequences, there are 128

consecutive sequences of calibrate mode, during which:

(1) coincidence requirements for the counting rates are modified as indicated in Table 10, and

(2) in the latter three readouts of a sequence each of the three analyzers are calibrated with pulses of different fixed amplitudes to monitor possible gain-shifts in the system.

#### 2.4 Telemetry Format

The IMP-4 and IMP-5 spacecrafts transmit one complete set of readouts every 20.48 seconds<sup>†</sup>, and this is called one SEQUENCE.

Every SEQUENCE is divided into 16 FRAMES (0 through 15) and each FRAME into 16 CHANNELS (0 through 15). The main portion of the University of Chicago output is contained in CHANNELS 8 through 15 of FRAMES 2, 6, 10, and 14 of each SEQUENCE. The analog ratemeter that monitors the D5 and D6 counting rates alternatively has its output in CHANNEL 15 of FRAME 4 of every SEQUENCE while the temperature of the University of Chicago instrument is in CHANNEL 14 of FRAME 12 of every even numbered SEQUENCE. The voltage delivered to the University of Chicago experiment is read out in CHANNEL 11 of FRAME 4

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<sup>†</sup> This is the nominal value. The University of Chicago uses a value of 20.45439 seconds for IMP-4.

of every SEQUENCE. Tables 9 and 10 show the telemetry format of the University of Chicago experiment on IMP-4 and IMP-5 respectively.

The rate accumulators are open only for 60 channels: from the beginning of channel 12 to the end of channel 7 four frames later; also the PHA registers are open for 59 channels: from the beginning of channel 0 to the end of channel 10 three frames later.

Each SEQUENCE telemetered during the life of the satellite is assigned a unique number called the pseudo-sequence count (PSC).

The PSC is the same as the Satellite Clock immediately after launch, and the PSC is increased by 1 for each sequence thereafter. The Decommunication Goddard Space Flight Center program run at the / handles the PSC assignment, including corrections for data gaps, recycling the satellite clock, and any abnormalities that might occur to the satellite clock. Thus the PSC is a linearly increasing clock which measures time in units of readout sequences. The PSC is used as the basic time monitor for all the University of Chicago data described in this document.

## 2.5 Performance

### 2.5.1 IMP-4

#### 2.5.1a Pre-launch

The instruments have been carefully calibrated prior to launch on its electronic characteristics and its response to protons and electrons. Table 11 shows the thresholds of the detectors and Table 12 tabulates the pulser calibration of the PHA's.

**THE UNIVERSITY OF CHICAGO IMP-4 TELEMETRY FORMAT**

TABLE 9

Channel Number of bits Accumulator	8	9	10	11	12	13	14	15
	10 7a (S-T)	10 7b (S-T)	12 7c (S-T)	3	3	8	8	8
2	E-2	D <sub>1L</sub> D <sub>2</sub> D <sub>3</sub> D <sub>4</sub> <sub>5</sub> D <sub>6</sub> cal: D <sub>5L</sub>	D <sub>1H</sub> D <sub>2</sub> D <sub>6</sub> cal: D <sub>4H</sub> prescale: 1/8	ID RRAS 1/2	D <sub>4</sub> . PHA	D <sub>2</sub> PHA	D <sub>4</sub> PHA	
F		D <sub>1H</sub> D <sub>2</sub> D <sub>3</sub> D <sub>4</sub> D <sub>5L</sub> D <sub>6</sub> cal: D <sub>4</sub>	D <sub>1H</sub> D <sub>2</sub> D <sub>3</sub> D <sub>6</sub> prescale: 1/128	"	"	"	"	
R				"	"	"	"	
A				"	"	"	"	
M								
E	IO	E-1 prescale: 2	D <sub>1L</sub> D <sub>2</sub> D <sub>3</sub> D <sub>4</sub> D <sub>5L</sub> D <sub>6</sub> cal: D <sub>5L</sub>	"	"	"	"	
I4		D <sub>1H</sub> D <sub>2</sub> D <sub>3</sub> D <sub>4</sub> D <sub>5L</sub> D <sub>6</sub> cal: D <sub>2</sub> prescale: 1/128	D <sub>1H</sub> D <sub>2</sub> D <sub>3</sub> D <sub>6</sub> cal: D <sub>2</sub> prescale: 1/128	"	"	"	"	

Analog Outputs:

1. D<sub>5L</sub>/D<sub>6</sub> in PP10 (once per sequence)  
D<sub>6</sub> During sequences 0 through 895 + 1024n ( $n \geq 0$ )  
D<sub>5L</sub> During sequences 896 through 1023 + 1024n
2. Telescope temp. in PP19 (once per two sequences)

Calibrate:

ID = 0  
Sequence normally within 7936 through 8063 + 8192n ( $n \geq 0$ )

Prescaling:

None except if: 1. RR1 = 1, D<sub>1H</sub>D<sub>2</sub>D<sub>6</sub> and D<sub>1H</sub> cal. prescaled by factor of 8  
D<sub>5L</sub> During sequences 896 through 1023 + 1024n  
2. RR2 = 1, D<sub>1H</sub>D<sub>2</sub>D<sub>3</sub>D<sub>6</sub> and D<sub>2</sub> cal. prescaled by factor of 128

TABLE 10

THE UNIVERSITY OF CHICAGO  
IMP-5 TELEMETRY FORMAT

Analog outputs: 1)  $D_5 L / D_6$  in PP12 (once per sequence);  $D_6$  during sequences 0 through 895 + 1024 n ( $n \geq 0$ );

D<sub>51</sub><sup>2</sup> during sequences 896 through 1023 + 1024n.  
2) Telescope temperature in PP 19 (once per 2 sequences)

Calibrate: ID = 0 and 7 in alternate sequences, during sequences from 7936 through 8063 + 81yz n (n  $\geq$  0)

PHA 1 - C<sub>K</sub> if ID = 6 or 7; D<sub>1</sub> if ID = 0, 1, 2, 3, 4, or 5.

**Prescale of D1D2D3D6** in 7b (6, in which case prescale is 128.

TABLE 11  
IMP-4 Detector Thresholds

D1 <sub>L</sub>	D1 <sub>H</sub>	D2	D3	D4	D5 <sub>L</sub>	D5 <sub>H</sub>	D6
(mV)	(mV)	(mV)	(mV)	(mV)	(V)	(V)	(mV)
0.34	0.65	1.20	0.81	0.37	.196	1.56	14.1

Threshold is defined as one-half of full triggering.  
D1<sub>L</sub> and D5<sub>L</sub> are set to include minimum ionizing protons; D5<sub>H</sub> is set to exclude lower than minimum ionizing He<sup>4</sup>; and D1<sub>H</sub> is set just above minimum ionizing protons.

Calibrations of the PHA by using a beam of accelerated protons between 15 and 200 MeV and cosmic ray muons give energy to pulse-height conversion factors which are compared with those obtained after launch in Table 13.

#### 2.5.1b Post-launch

The satellite IMP-4 was launched on 24 May 1967 and terminated its life on 3 May 1969. During its mission the University of Chicago instrument went through temperature variations (seasonal and secular) as shown in Figure 8 which did not exceed the thermal specifications of the instrument, except for the severe temperature drops, not shown on the curve, during the two ~ 7-hour shadows.

Figures 9a, b and c show the shifts in the D1, D2 and D4 PHA systems, respectively, as indicated by the in-flight pulser calibrations. The shifts of the analyzers also can be checked for any part of the mission by

TABLE 12. IMP-4 PHA Calibration

noting the positions of the proton and He<sup>4</sup> tracks. Using the latter method, the energy to pulse-height conversion factors from orbits 1-36 are shown in Table 13.

TABLE 13  
IMP-4 Conversion Factors

PHA	Pre-launch		Orbits 1 thru 36		Units
	Muon	Proton	Proton	He <sup>4</sup>	
D1	-	191 $\pm$ 18	193 $\pm$ 16	200 $\pm$ 16	keV/mV
D2	-	214 $\pm$ 18	204 $\pm$ 16	201 $\pm$ 16	keV/mV
D4	20.8 $\pm$ 2.9	25.4 $\pm$ 2.2	22.0 $\pm$ 2.0	20.8 $\pm$ 2.0	MeV/mV

The PHA system as a whole was quite steady throughout the mission, except the D3 detector malfunctioning disturbed the range ID and the deterioration of the D4 system caused an ID = 4 analysis difficulty toward the end of 1967. A list of historical events in the life of the instrument is shown in Table 14.

TABLE 14  
IMP-4 Satellite History

IMP-4      1967-51-A      Explorer 34

Launch: WTR May 24, 1967 (Day 144)

First Quick-look data received:      June 1, 1967 (Day 152)

First Production data received:      Aug. 2, 1967 (Day 214)

Last Production Data received:      Oct. 7, 1969 (Day 280)

<u>Day</u>	<u>Orbit</u>	<u>Description</u>
May 30, 1967 (Day 150)	2	E2 rate fails, returns all zeros.
Sept. 21, 1967 (Day 264)	28	E1 rate goes noisy.
Nov. 16, 1967 (Day 320)	41	D3 begins to go noisy*
Dec. 11, 1967 (Day 345)	47	D4 calibrate peak begins to spread.
Jan. 15, 1968 (Day 15)	55	D4 proton track begins to degrade.
Mar. 5, 1968 (Day 65)	67	Begin getting 2 peaks in D3 calibrate.
Mar. 7, 1968 (Day 67)	67	First Shadow, ~ 7 hours long, electron telescope dies.
Sept. 17, 1968 (Day 261)	112	D3 noisy at $\sim 7 \times 10^4$ c/sec from here to end of mission.
Oct. 16, 1968 (Day 290)	119	ID2 proton track shifted one channel.
March 4, 1969 (Day 63)	151	Second shadow, ~ 7 hours long; there is no valid optical aspect data after this.
May 3, 1969 (Day 123)	164	Last day of data.

\* Fairly quiet from 110'68 to 149'68 (orbits 77-87). Then noisy to end.

### 2.5.2 IMP-5:

### 2.5.2a Pre-launch

The instrument has been carefully calibrated prior to launch on its electronic characteristics and its response to protons and electrons. Table 15 shows the thresholds of the detectors and Table 16 tabulates the pulser calibration of the PHA's.

TABLE 15

## IMP-5 Detector Thresholds

D1	D2	D3	D4	D5 <sub>L</sub>	D5 <sub>H</sub>	CK	D6
(mV)	(mV)	(mV)	(mV)	(mV)	(mV)	(mV)	(mV)
0.685	1.35	0.640	0.275	0.105	1.39	2.08	19.6

Threshold is defined as one-half of full triggering. Thresholds are measured at room temperature.

All detector thresholds are set to include minimum ionizing protons, except:

D1: includes only about 1/3 of minimum ionizing protons. If a particle fails to trigger D1 but does trigger CK, it is analyzed as a low priority event with ID = 0. In this case, PHA1 is assigned to CK.

CK: does not trigger on most protons moving backwards through the telescope. If such events trigger D1, they will be analyzed as ID = 5 events.

$D_{5H}$  threshold: This threshold determines whether or not an event of ID = 5 or 6 will be high or low priority. Particles that do not pass through one of the D5 photodiodes must deposit  $\sim 63$  MeV in the D5 CsI crystal to trigger  $D_{5H}$ . If a particle passes through a photodiode, it will always trigger  $D_{5H}$  if its charge is  $\geq 2$ . Summarizing, for ID = 5 or 6,

- 1)  $Z = 1$  all particles have low priority.
- 2)  $Z = 2$  a) Forward moving particles of incident energy  $< 220$  MeV/nucleon are high priority.  
b) Forward moving particles ( $\gtrsim 220$  MeV/nucleon) and backward moving particles (all energies) have high priority  $34.5 \pm 2\%$  of the time, since they hit a photodiode (this applies to  $36^\circ$  cone only).
- 3)  $Z \geq 3$  all particles have high priority.

TABLE 16. IMP-5 PHA Calibration

Pulser Input (mV)	Channel Numbers				Pulser Input (mV)	D1	D2	Channel Numbers	
	D1	D2	D4	CK				D4	CK
0.3				Threshold at 2.7 mV	60.0	100.0	57.0	172.5	4.5
0.4	1.9				70.0	116.0	63.0	177	48
0.5	2.2				80.0	130.0	75.5	181.5	54
0.6	2.7			Threshold at 0.69 mV	90.0	133.0	84.0	186	62
0.7	3.1				100.0	134.0	94.0	190.5	68
0.8	3.2				150.0	142.0	140.0	214	102
0.9	3.4				170.0	144.5	159	223	111
1.0	3.6			Threshold at 1.35 mV	180.0	146.0	168	228	113
1.1	3.7				190.0	147.5	177	232.5	116
1.5	4.5	2.5	6.6	Threshold at 2.1 mV	200.0	149.0	187	237	119
2.0	5.3	3.0	8.6		280.0	160.5	260	248	141
3.0	6.9	3.9	12.5		300.0	163.5	268	250	147
4.0	8.5	4.9	16.5		320.0	166.5	273	Limit	152
5.0	10.1	5.8	20.5		340.0	169.0	276		157
6.0	11.7	6.8	25.5		400.0	178.0	282		173
7.0	13.3	7.7	30.0		7.5				201
8.0	14.9	8.7	34.0		8.1	500.0	192.5	292	
9.0	16.4	9.6	38.5		8.7	600.0	207.0	302	
10.0	18.0	10.5	42.0		9.3	700.0	221.5	312	
12.0	21.0	12.3	50.0		10.6	800.0	237	321	
14.0	24.5	14.2	59.0		11.9	900.0	245	331	
16.0	27.0	16.1	66.0		13.1	1.0 V	Limit	341	
								388	
18.0	31.0	19.0	75.0		14.5	1.5 V		435	
20.0	34.5	19.2	82.5		15.7	2.0 V		482	
30.0	51.0	29.5	124.0		22	2.5 V		500	
40.0	67.0	39.0	162		22	3.0 V		3.5 V	
	84.0	47.5	168		35				

## 2.5.2b Post-launch

An appendix to this document, which will be submitted at a later date, will contain the post launch performance of the IMP-5 instrument, as well as a comparison of pre-launch and post-launch response to protons and electrons.

### 3. Data Format of the Magnetic Tapes

#### 3.1 General Description

All magnetic tapes were generated on an XDS 930 computer at a density of 800 BPI on seven track tape. Each tape is labelled with an appropriate mnemonic of the type of data recorded on it: 'RAST' for RAtte Summary Tape, 'RAPT' for RAtte Packed Tape, 'PHAEST' for Pulse Height Analysis Event Summary Tape, and 'ORPT' for ORbit Parameter Tape. In addition, a number representing the sequential order of the tape in its respective category appears on the tape label.

An end of file mark terminates each orbit and a double end of file mark terminates the last orbit of each tape. An orbit contains a variable number of physical records. 'ORPT', 'PHAEST', and 'RAPT' are written in binary, odd parity. The 'RAST' is written in blocked BCD, even parity, 6 bits per character.

Table 17 summarizes the logical and physical segmentation of the magnetic tapes.

TABLE 17  
Summary of Tape Format Physical and Logical Divisions

Tape Type	RAST	RAPT	PHAEST	ORPT
Format Type	Blocked BCD	Binary	Binary	Binary
Number of Orbita per Magnetic Tape	100	30	20	33 IMP-4 44 IMP-5
Number of Logical Records per Physical Record	57	102	200	40
Number of Words* per Physical Record	1881 <sup>†</sup>	816	600	1000
Number of Words* per Logical Record	33	8	3	25
Total Number of Magnetic Tapes in IMP-4 Submission	2	6	9	5

\* XDS 930 binary, 24 bits per word.  
† Short records do occur, but only immediately before an EOF.

The data on all tapes are ordered so that time and PSC are monotonically increasing, with discontinuities only at points where no data was received or where the data quality\* of a particular sequence was other than good or fair.

The following word-bit placement convention is used in the data format descriptions. The lowest word and bit number is located closest to the beginning of the physical record, the beginning of the file, and the beginning of the tape. Similarly, 'File 1' of a tape is located immediately after the load point marker at the beginning of that tape. Furthermore, the

\* See GSFC X-563-69-292 section 2.7.

TABLE 18  
RAPT LOGICAL RECORD SPECIFICATION

Item Number	Item Name	Location Within Logical Record		COMMENTS
		WORD	BITS	
1	Calibrate/Normal Flag	1	0	Value = $\begin{cases} 0, \text{In Calibrate Mode} \\ 1, \text{In Normal Mode} \end{cases}$
2	End of Orbit Flag	1	1	Value = $\begin{cases} 1, \text{Normally} \\ 0, \text{At end of orbit where all remaining logical records in the last physical record are filled with zeros.} \end{cases}$
3	Pseudo Sequence Count	1	2 thru 23	See Section 2.4.
4	Accumulator 7C Frame 2	2	0 " 11	
5	Accumulator 7C Frame 6	2	12 " 23	See Tables 9 and 10.
6	Accumulator 7C Frame 10	3	0 " 11	
7	Accumulator 7C Frame 14	3	12 " 23	
8.	Prescale Flag Frame 2	4	0 " 1	
9.	" " " 6	4	2 " 3	Value = $\begin{cases} 0, \text{Not in Prescale Mode} \\ 1, \text{D1D2D3D6 is prescaled} \\ 2, \text{D1D2D6 is prescaled} \\ 3, \text{Both D1D2D6 and D1D2D3D6 are prescaled.} \end{cases}$
10.	" " " 10	4	4 " 5	
11.	" " " 14	4	6 " 7	
12.	Data Quality Flag Frame 2	4	8	
13.	Data Quality Flag Frame 6	4	9	
14.	Data Quality Flag Frame 10	4	10	Flag Value = $\begin{cases} 0, \text{All data items have good quality.} \\ 1, \text{One or more items had fair quality; or one item had poor quality, so, all data items are filled, with ones.} \end{cases}$
15.	Data Quality Flag Frame 14	4	11	
16.	Geocentric Distance of Satellite	4	12 thru 20	In tenths of earth Radii
17.	Overlap elimination flag	4	21 " 23	A value of '5' indicates the elimination of overlap.
18.	PHA Duplicate event Flag	5	0	Value = $\begin{cases} 0, \text{there is a record of this frame on the PHAEST.} \\ 1, \text{There is not a record of this frame on the PHAEST, because there were no events collected during this frame.} \end{cases}$
19.	Frame 14	5	1	
20.	Frame 10	5	2	
21.	Frame 6	5	3	
22.	Frame 2	5	4 thru 13	
23.	Accumulator 7A Frame 6	5	14 " 23	
24.	Accumulator 7A Frame 10	6	0 " 9	
25.	Accumulator 7A Frame 14	6	14 " 23	See Tables 9 and 10
26.	Accumulator 7B Frame 2	7	0 thru 9	
27.	Accumulator 7B Frame 6	7	14 " 23	
28.	Accumulator 7B Frame 10	8	0 " 9	
29.	Accumulator 7B Frame 14	8	14 " 23	
30.	Sun Time	6, 7, 8,	10 " 13	In milli-seconds. Word 6 contains most significant part, and word 8 contains the least significant part.

bit significance increases as the bit position number decreases; e.g., for a value stored completely in bits 9 through 14 of a word, bit 9 (when it is on) holds the value  $2^5$ , bit 10 holds  $2^4$ , and so on until bit 14 which represents  $2^0$ .

### 3.2 RAtE Packed Tape--RAPT

The RAtE Packed Tapes contain the S-T Accumulator readouts and related data exactly as telemetered from the spacecraft. As can be seen in Table 17 all physical records on the RAPT are 816 words in length, divided into 102 logical records of 8 binary packed words. Table 18 specifies the data item to word and bit correspondence.

#### 3.2.1 S-T Accumulators

There are three Scaler-Timer accumulators: two 10-bit (7a and 7b) and one 12-bit (7c). Each S-T accumulator operates as a scaler until the high order bit is set, e.g. 512 counts in a 10-bit accumulator, then the accumulator ceases to accept data pulses and starts to operate as a timer which measures the residual accumulation time from a spacecraft clock. For the 10-bit accumulators the clock has a frequency of 100 Hz and for the 12-bit accumulator 400 Hz; whence for the nominal accumulation time of 4.8 seconds, the high order bit, once set for time-mode (T-mode), is not reset until the end of readout when the accumulators are always zeroed.

#### 3.22 Sun Time

The sun time is the time interval in milliseconds starting at the beginning of channel 0 of frame 0 of the given sequence and ending at the first detection of the sun by the Optical Aspect sensor.

Table 19  
RAST LOGICAL RECORD SPECIFICATION

Item Number	Item Name	Format *	Description
1	Day	I3	This Data pertains to the <u>Last</u> point of the interval from which the following rate averages were computed.
2	Hour	I2	
3	Minute	F4.1	
4	Chicago Sequence Count	I8	
5	Satellite Geocentric Distance in Earth Radii	F4.1	
6	D5 /D6 analog Ratemeter Average Rate	E12.5	All Rate Averages are in counts/second
7	Accumulator 7B Frames 2 thru 14	E12.5	
8	Accumulator 7B, Frames 6 and 14	E12.5	
9	Accumulator 7A Frames 6 & 14	E12.5	
10	Accumulator 7B Frames 2 & 10	E12.5	
11	Accumulator 7A, Frame 10	E12.5	
12	Accumulator 7A, Frame 2	E12.5	
13	Temperature	F6.2	In Degrees Centigrade
14	Number of Good Frames	I3	Only frames in which all the Data qualities were 'Good' are used in computing rate averages
15	Total Number of Frames	I3	If a frame contains even one data quality below 'Good', it is discarded, or if an 'overlap' condition is encountered, the second CSC or poorer quality CSC is discarded. This item is the total of all types of frames encountered in the 15 sequence count interval.

\* Each item is led by a space 1X.

TABLE 20  
PHAEST LOGICAL RECORD SPECIFICATION

Item Number	Item Name	Location Within Location Record		Comments
		Word	Bits	
1.	PSC	1	0 thru 23	See Section 2.4
2.	PHA Accumulator 1	2	0 thru 7	
3.	" " 2	2	8 " 15	See Tables 9 and 10.
4.	" " 3	2	16 " 23	
5.	Range ID	3	0 " 2	See Section 2.
6.	Angular Sector	3	3 " 5	
7.	Frame Number	3	6 " 7	Instead of 2, 6, 10, and 14 we have respectively 0, 1, 2, 3.
8.	Data Quality Flag	3	8	Value = {0, all data qualities are good 1, at least one data quality was fair but none were lower than fair.}
9.	Orbit Number	3	9 thru 15	Least significant part of orbit number (for orbits 1 through 127)
10.	Orbit Number	3	16	Most significant bit (for orbits 128 through 255.)
11.	PHA Accumulator 2	3	17	The most significant bit of item 3. (This bit was added to accomodate the 512 channel D2 PHA analyzer on IMP-5.)
12.	End of orbit flag	3	18 thru 23	Value = {1, during orbit 0, at end of orbit (the remaining logical records in the last physical record are filled with zeroes.)}

TABLE 21  
ORPT LOGICAL RECORD FORMAT

Word Number Within Logical Record	Parameter Name	Description and Comment
1	Pseudo Sequence Count	This is the PSC for which the following orbit data is applicable.
2	Coordinate recomputation flag.	If non zero, then items 13 and 15-18 were in error and have been corrected at the University of Chicago.
3	Geocentric Distance of Satellite	In thousandths of an earth radius.
4 5 6	<del>Day of Year</del> X of satellite in geocentric <del>Hour of Day</del> Y Solar ecliptic <del>MSEC of Hour</del> Z reference frame	<del>Time for which orbit data is valid. (January 1 - day 1)</del>
7	Satellite-Earth-Sun Angle	In thousandths of a degree.
8 9	In the geomagnetic reference frame: Geomagnetic Longitude of Satellite Geomagnetic Latitude of Satellite	In all the geomagnetic reference frames, the assume location of the north magnetic pole is 69.0° west longitude, 78.2° north latitude. In thousandths of a degree.
10 11 12	In the Solar Magnetospheric Coordinate System: X Coordinate Y Coordinate Z Coordinate	In thousandths of an earth radius.
13 14	Geomagnetic Longitude of the Sun Geomagnetic Latitude of the Sun	In thousandths of a degree.
15 16	Geocentric Longitude of the Satellite Geocentric Latitude of the Satellite	In thousandths of a degree.
17 18	Geocentric Longitude of the Sun Geocentric Latitude of the Sun	In thousandths of a degree.
19	Speed of Satellite	In meters/second
20	t, McIlwain Parameter	In thousandths of an earth radius.
21	B, Field Strength	In milligauss
22	B/B <sub>0</sub>	Dimensionless x 100
23 24 25	Theoretical Geomagnetic Field in Solar Ecliptic Coordinate System: X Coordinate Y Coordinate Z Coordinate	In milligauss

### 3.3 RRate Summary Tape--RAST

The RRate Summary Tapes contain counting rates averaged over consecutive time intervals of 15 PSC's ( $\sim 5$  minutes) using only data of good quality. The last PSC in the period averaged over is assigned to the rate average. The physical and logical record size are given in Table 17.

Each logical record is generated with the following Fortran II format.

ITEM:	1	2	3	4	5	6 - 12	13	14	15
FORMAT	(IX, I3, 1X, I2, 1X, F4.1, 1X, I8, 1X, F4.1, 7 (IX, E12.5), 1X, F6.2, 1X, I3, 1H/I3)								

The item names, units, and other specifications are displayed in Table 19.

#### 3.3.1 Exceptions to the Standard Format

When reading the data from the tape, the above format statement is used except when reading the first logical record of each orbit which logical record is a heading. The second logical record of each orbit, although written in the above data format is not a data line and contains the following substitutions:

Day, Hour, Minute and

- 1) ITEMS 1 through 4 contain the PSC for the first good data of the orbit.
- 2) ITEM 5 contains the orbit number.
- 3) ITEM 6 contains the geocentric distance of the satellite in kilometers.
- 4) All other ITEMS are filled with zeroes.

Similarly the last logical record of an orbit does not contain experiment data, but has the following substitutions:

- 1) ITEMS 1 through 3 contain the time of the last good data of the orbit.
- 2) ITEM 4 = -1, thus acting as a sentinel flag for the orbit.

- 3) ITEM 6 contains the total number of frames in the orbit.
- 4) ITEM 11 contains the total number of frames used (only good quality) to compute the rate averages in the orbit.
- 5) ITEM 12 is superceded by ITEM 6.
- 6) All other ITEMS are filled with zeroes.

The last physical record of a file terminates at the end of the orbit contained in that file. Hence, the number of logical records in the last physical record is usually less than the normal 57.

### 3.3.2 Calibrate Mode

When the instrument is in calibrate mode all counting rates are zeroed, except the D5/D6 Analog Ratemeter.

### 3.3.3 Analog Ratemeter

Although the Analog Ratemeter alternates between the D5 and D6 (see telemetry formats), these modes are not mixed when averaging is performed for the RAST. The mode the instrument is in at the beginning of the interval is the mode for that entire interval; ie., if the satellite switches mode during the interval, the new mode readouts are discarded.

### 3.4 Pulse Height Analysis Event Summary Tape--PHAEST

These tapes contain, among other pertinent data, the pulse height analyzer accumulator readouts as telemetered by the spacecraft. Only events with associated data qualities of 'good' or 'fair' are recorded on these tapes. As stated in Table 17 all physical records contain 600 words, divided into 200 logical records of 3 binary packed words. Each logical record contains all the data for one event.

If no events are collected during a frame, then there is no record of that frame on the PHAEST.

Table 20 itemizes the data item to word-and-bit correspondence within a logical record.

### 3.5 ORbit Parameter Tape--ORPT

These tapes contain trajectory data furnished by GSFC.

Referring to Table 17 a physical record consists of 1000 binary packed words, divided into 40 logical records of 25 words. The complete set of orbit data contained in each logical record applies to the PSC appearing in that logical record.

Between consecutive logical records there normally is an increment of three PSC's (~ 1 min. ). Table 21 contains the correspondence between data items and words within a logical record.

The parameter values are written in standard XDS 930 Integer format. That is, eight octal digits (one XDS 24-bit word) are allocated for each value. The most significant octal digit has only two bits since its leading bit (bit position zero of the word) represents the sign. If the sign bit is off (value: zero), the number is positive and represented in binary integer form with the most significant bit having the lowest bit position ('bit 1' is the lowest bit position). This is identical to the data representation used on the RAPT and PHAEST, except that every parameter now has a sign bit, and every value has exactly 23 bits. However, if the sign bit is on (value: one), the number is negative and represented in two's complement form.

4. Format for the Counting Rate Plots on Microfilm

The plots were computer generated on a Cal/Comp 563 plotter with the vertical axis representing the rate in counts per second, and the horizontal axis representing a time period of 30 days beginning on the first day of a Bartels Solar Rotation and ending three days into the following Solar Rotation. The horizontal scale is one day per division, and the vertical logarithmic scale varies for each range interval. Every horizontal fiducial is labelled with the PSC and the day of year (January 1 = Day No. 1). The year is printed at the origin and whenever it changes. Each plotted point represents a rate averaged over 45 sequences.

The heading of each plot contains the satellite number\*, the Bartels Solar Rotation number, the range interval expressed as detector coincidence, and the date of generation of the plot\*\*.

Table 22 specifies the time and solar rotation intervals covered.

TABLE 22  
Microfilm Data Coverage

IMP-No.	Bartel's Solar Rotation No.	Dates (UT)
1	1783 - 1790	11-27-63 to 5-29-64
2	1795 - 1802	10-4-64 to 4-5-65
3	1804 - 1830	5-29-65 to 5-2-67
4	1831 - 1856	5-24-67 to 4-29-69
5	1859 -	6-21-69 to (> 3/71)

\* Plots are being submitted for IMP 1, 2, 3 and 4 in microfilm form. (One roll of microfilm per satellite.)

\*\* This date has no connection with the data.

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## FIGURE CAPTIONS

- Figure 1 Location and orientation of University of Chicago experiment on IMP-4, showing position of acceptance cones of the composition and electron telescopes.
- Figure 2 Location and orientation of University of Chicago experiment on IMP-5. Note that there is no electron telescope on this experiment. Only the 55° acceptance cone of the telescope is indicated (see Figure 4).
- Figure 3 Schematic drawing of detector layout in IMP-4 Composition and Electron telescopes. Detector housings and mountings are not shown.
- Figure 4 Schematic drawing of Composition telescope on IMP-5.
- Figure 5 Simplified logic diagram of the IMP-4 experiment. This diagram shows only the normal mode operation of the instrument.
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- Figure 8 Temperature history of IMP-4 experiment. The semi-sinusoidal variations are due to seasonal variation of the distance to the sun, while the overall rising trend is due to ultra-violet degradation of white thermal paint on the experiment facet.
- Figure 9 Location of IMP-4 in flight calibrator pulsar peaks throughout the mission. Note increasing spread of peaks in D4 PHA as the experiment aged.
- a) D1
  - b) D2, and
  - c) D4

The University of Chicago  
Composition Telescope, IMP-4

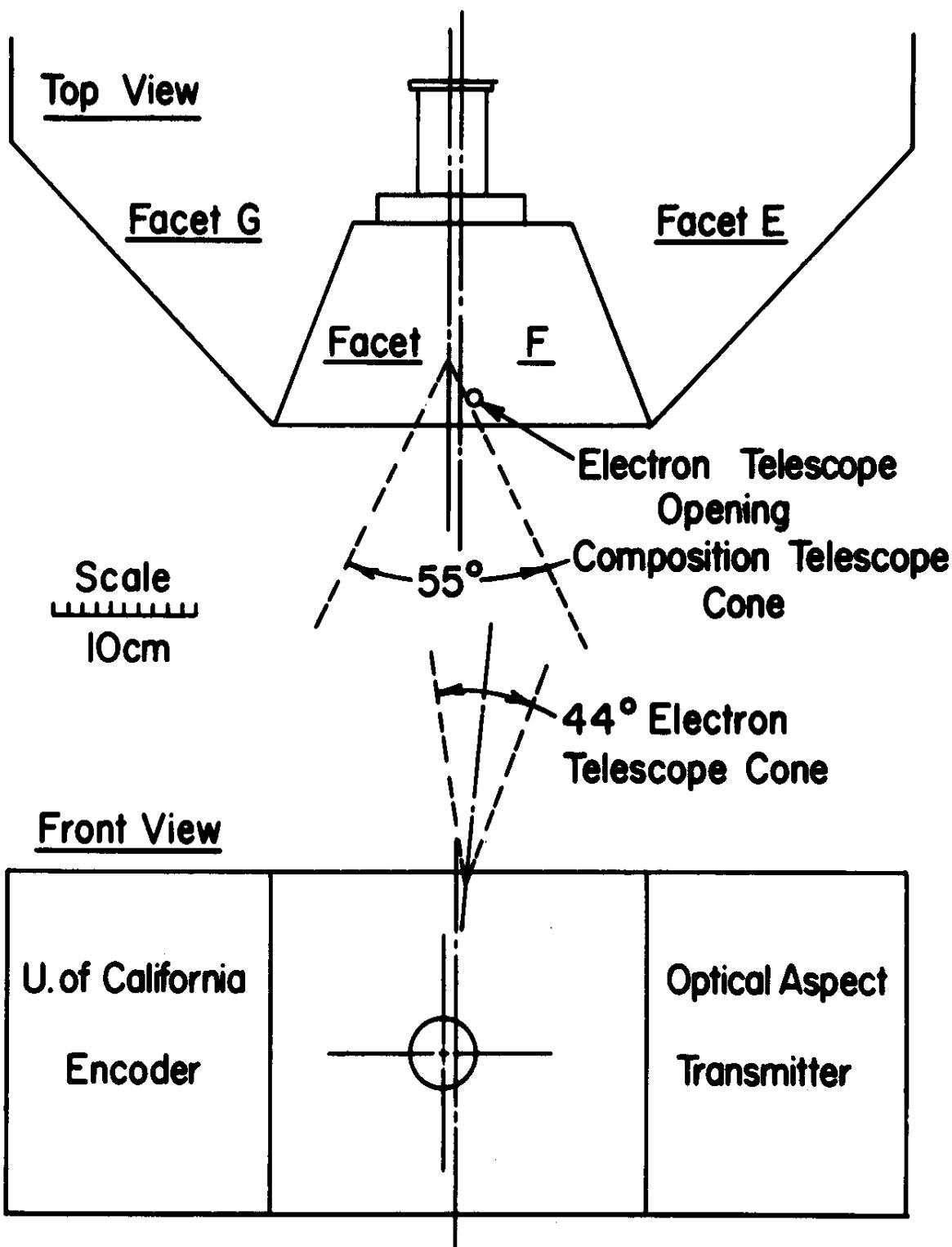


Figure 1

**IMP - 5**  
**Location and Orientation of**  
**University of Chicago Experiment**

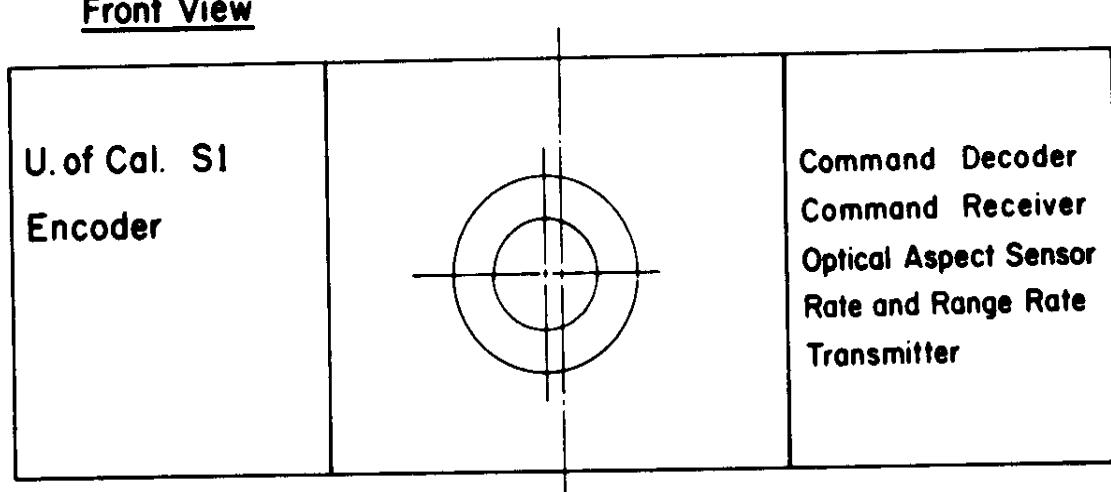
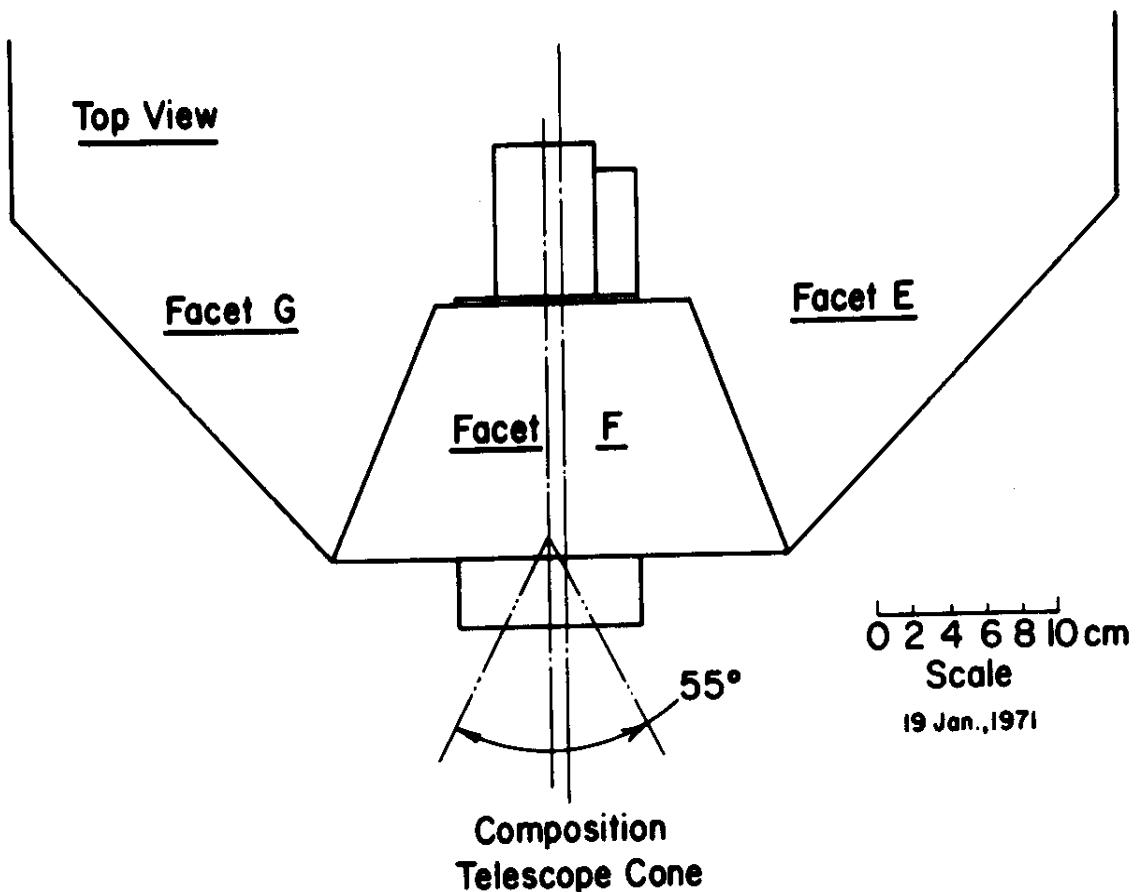
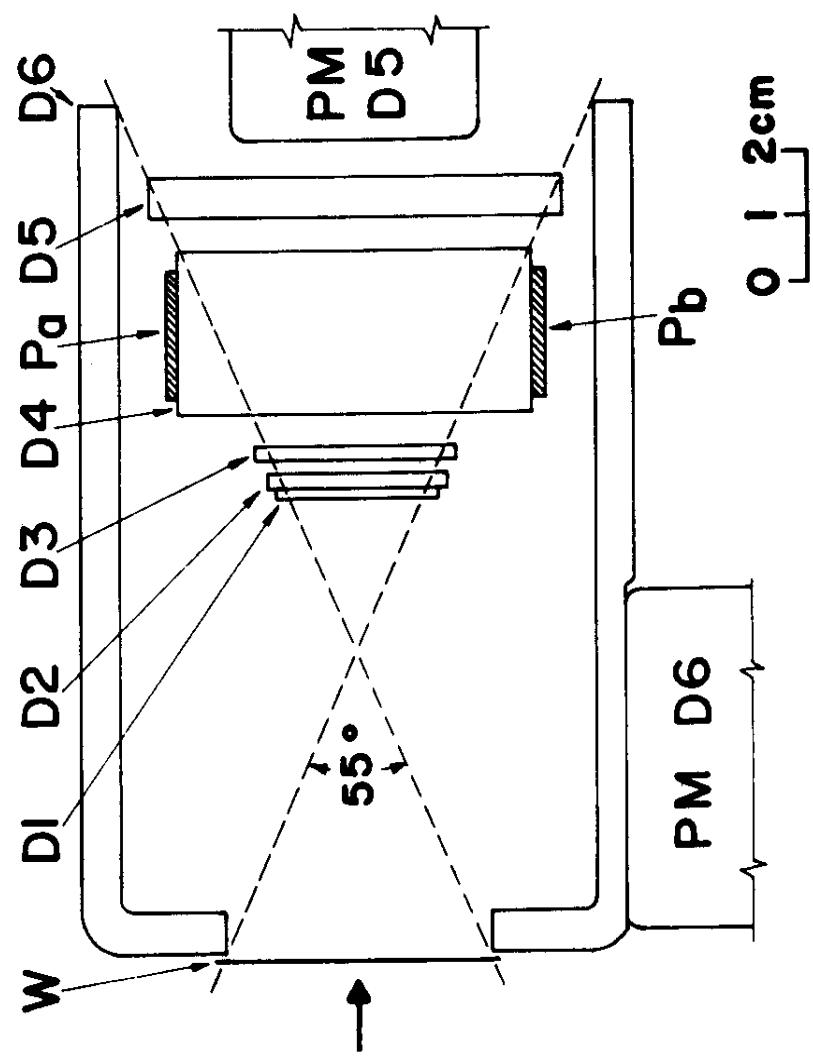


Figure 2

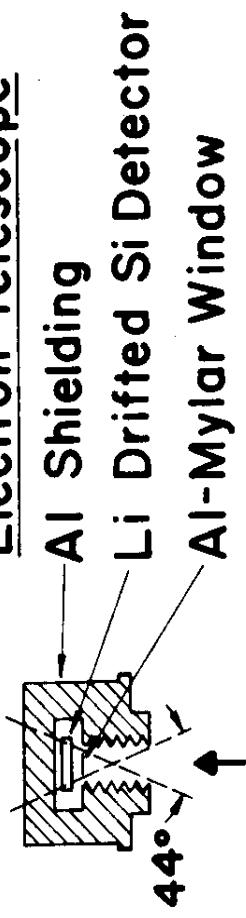


### Composition Telescope

W — Al-Mylar Window

- D1 } Li-Drifted Si Detectors
- D2 }
- D3 }
- D4 — CsI(Tl) Crystal Viewed by Pa, Pb Au-Si Photo Diodes
- D5 — Plastic Scintillator
- D6 — Anti-Coincidence Plastic Scintillator
- PM — Photomultiplier

### Electron Telescope

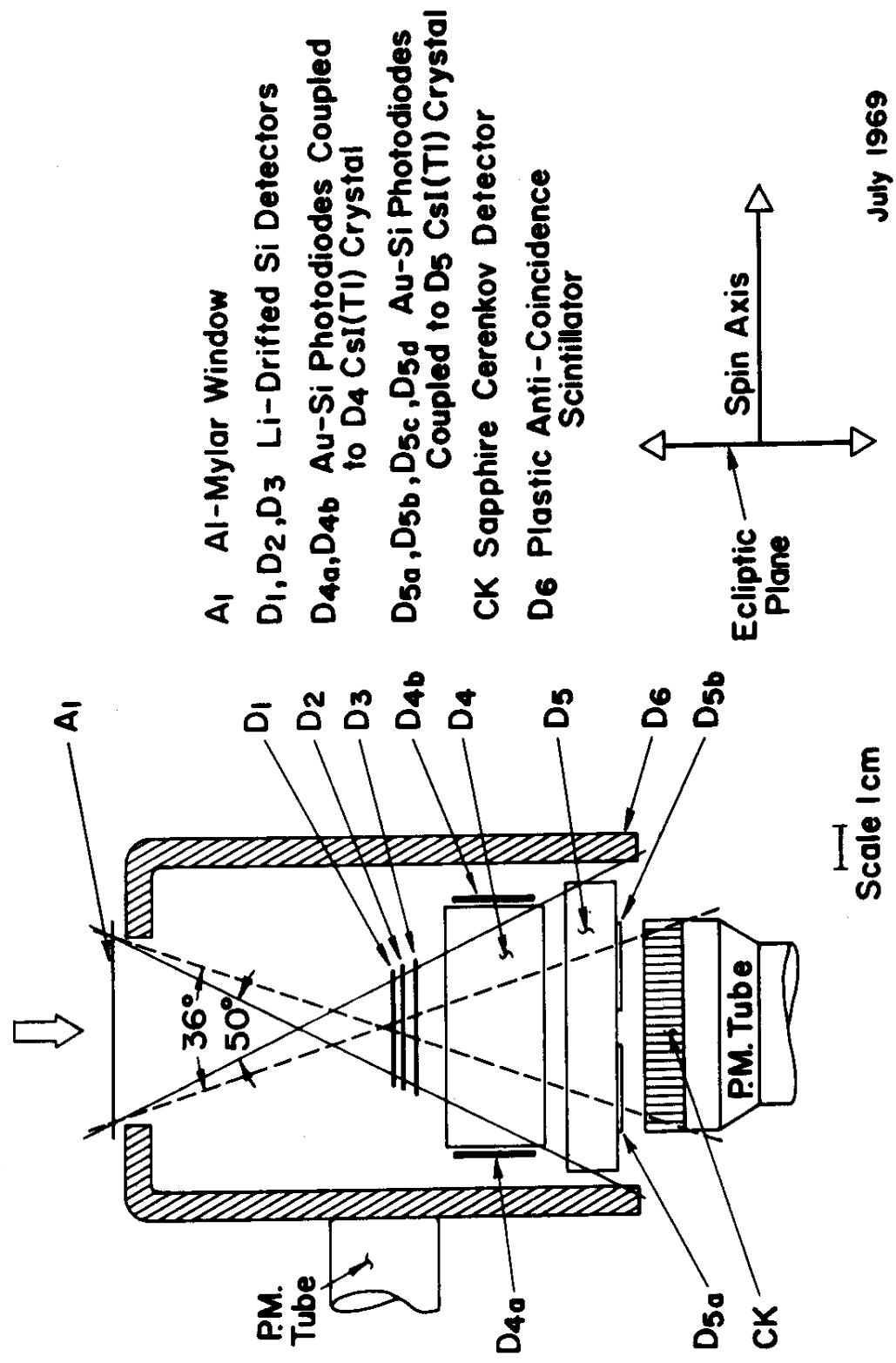


Spin Axis

## IMP - 4 The University of Chicago

Figure 3

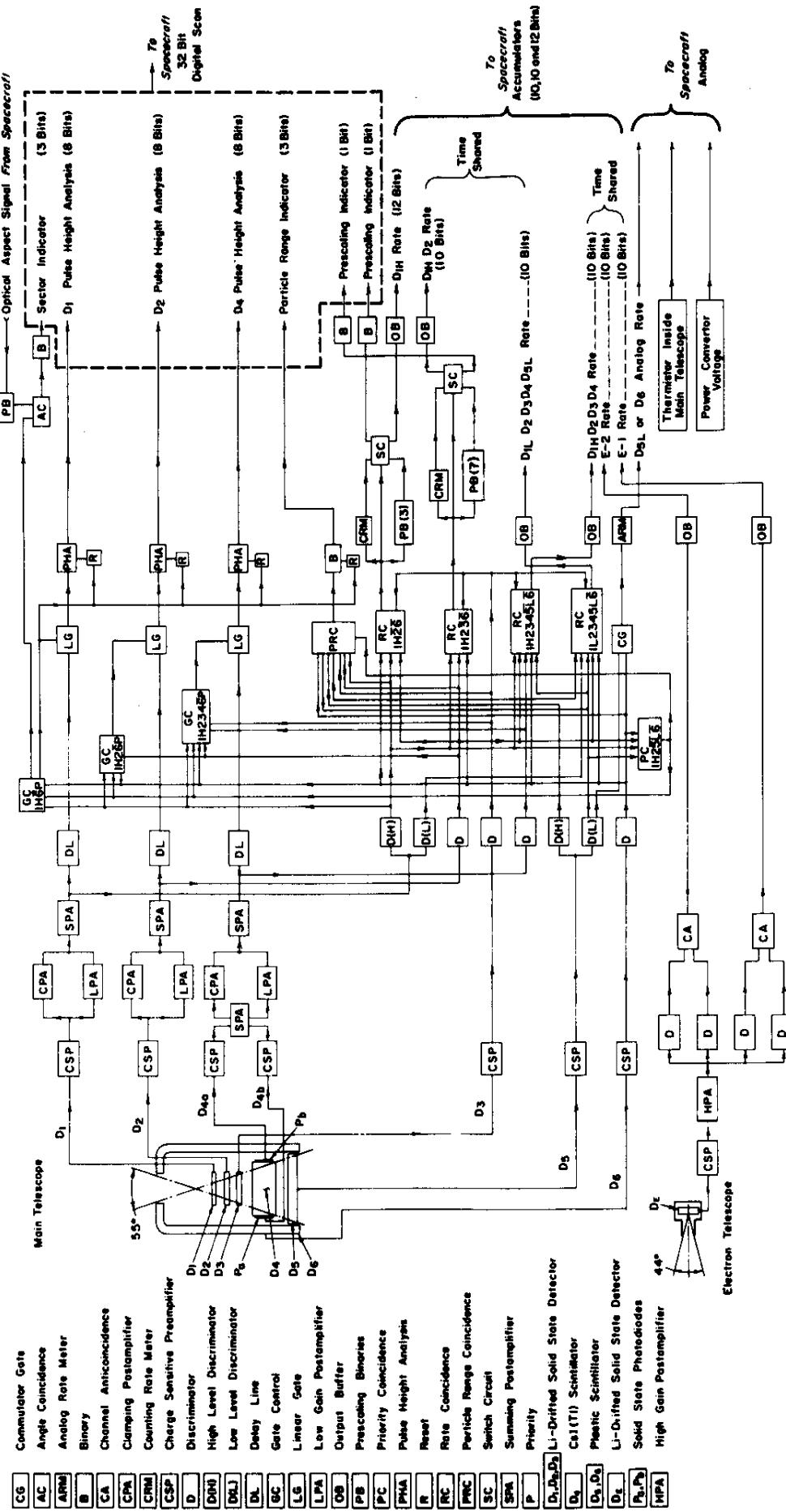
Composition Telescope  
IMP 5 The University of Chicago



July 1969

Figure 4

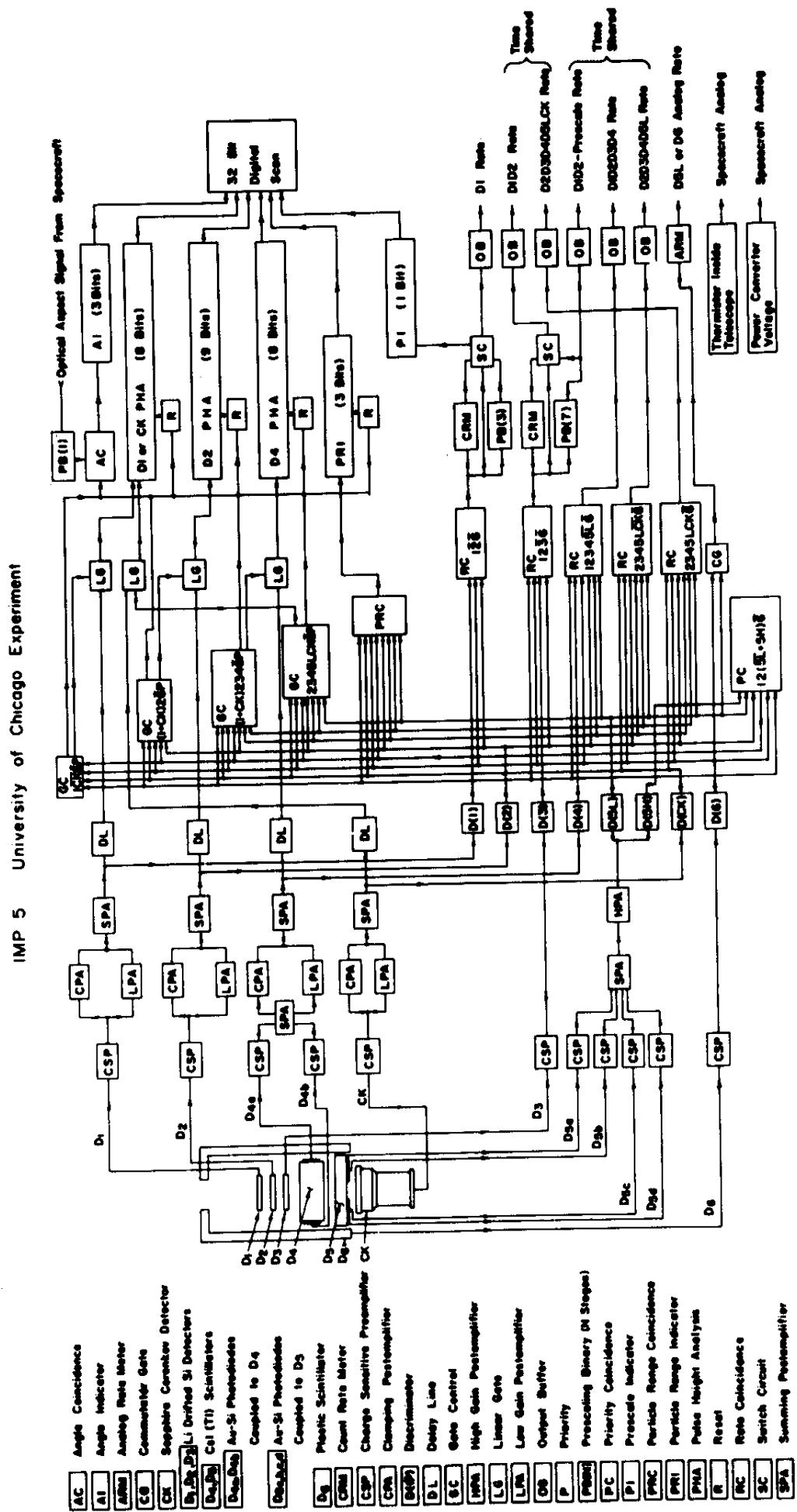
IMP-4 UNIVERSITY OF CHICAGO EXPERIMENT



An arrow pointing to the right, indicating the direction of incident flow.

**Figure 5**

**Figure 6**



# Angular Sector Orientation of The University of Chicago Composition Telescopes on IMP-4 and IMP-5

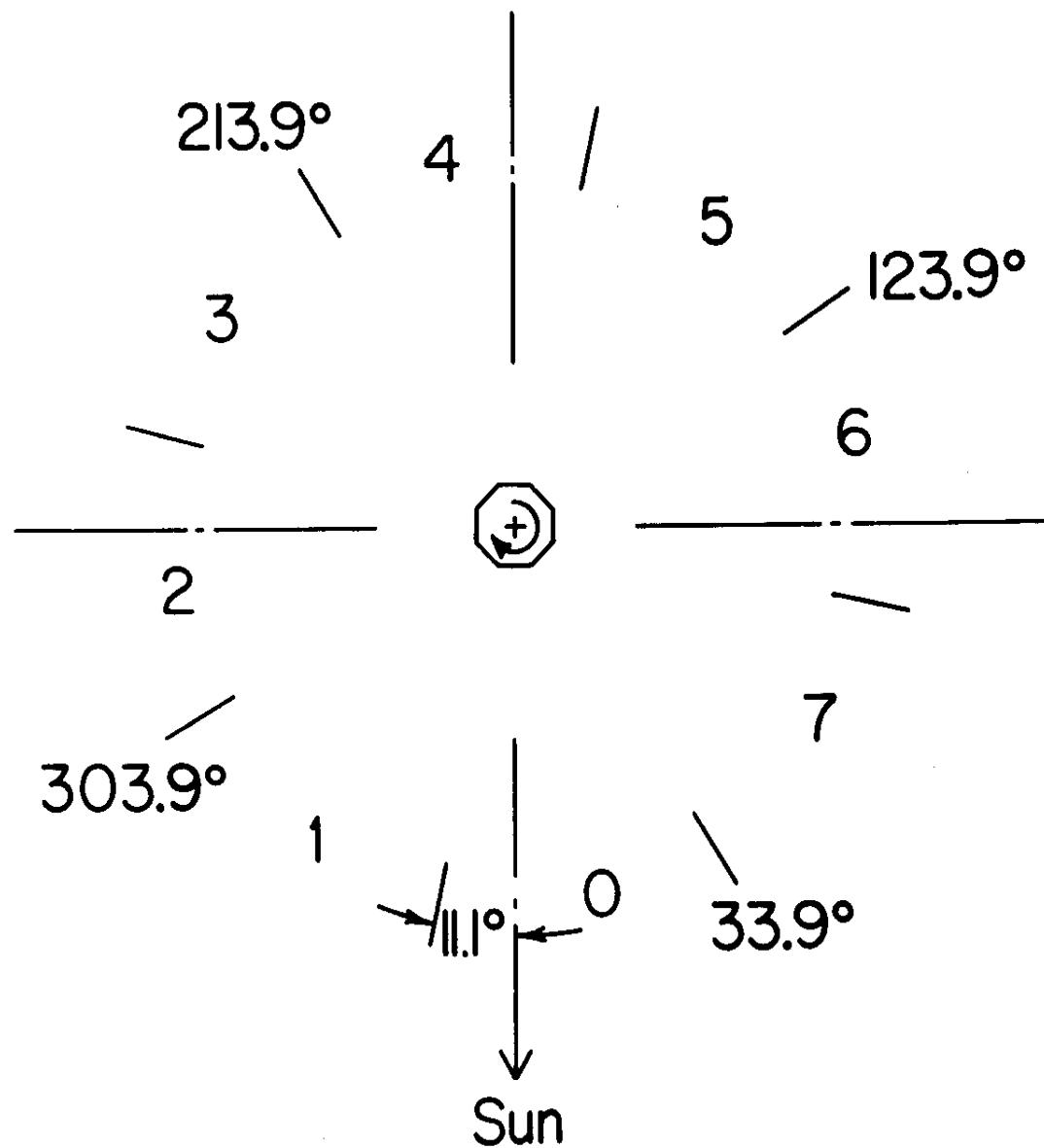


Figure 7

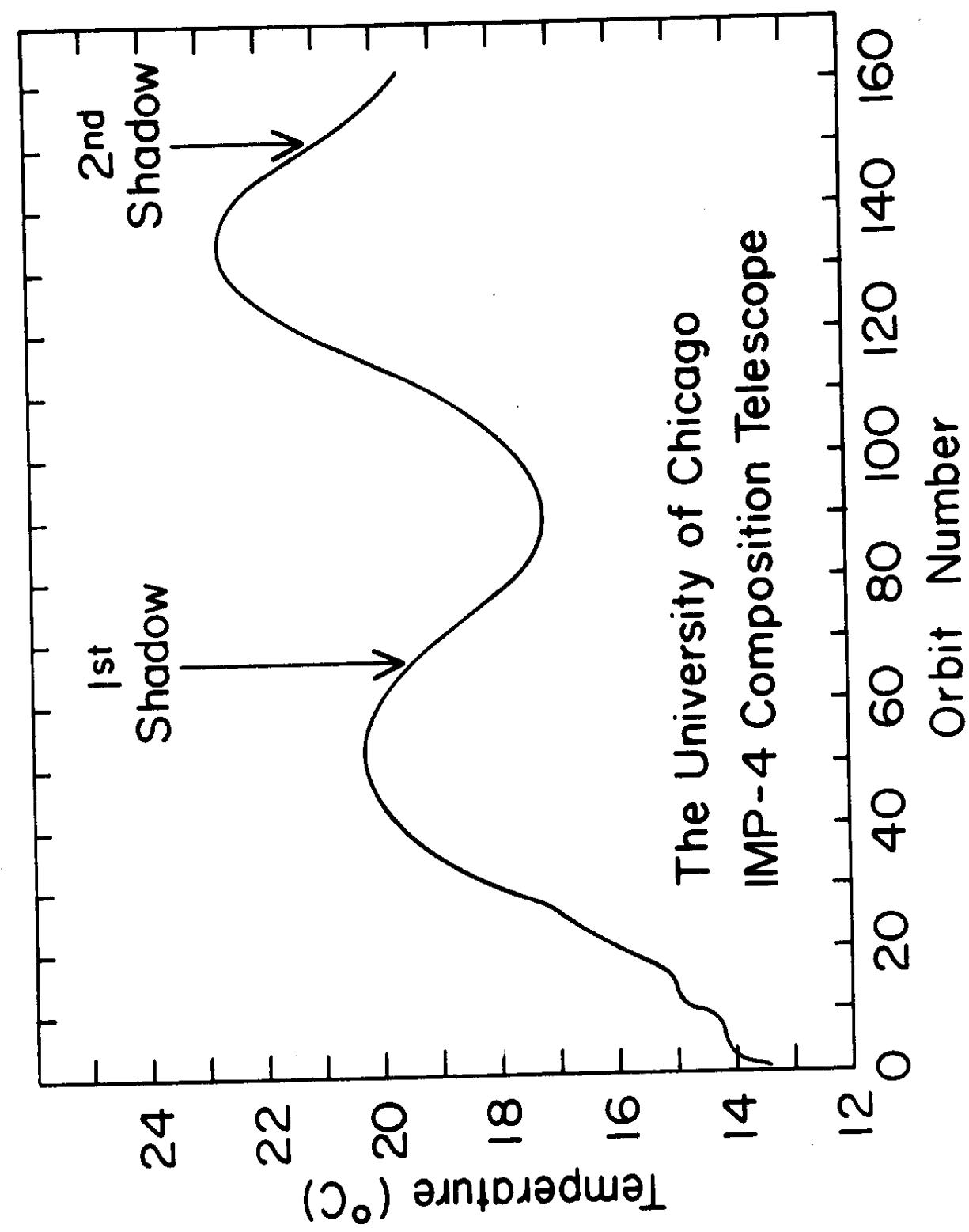


Figure 8

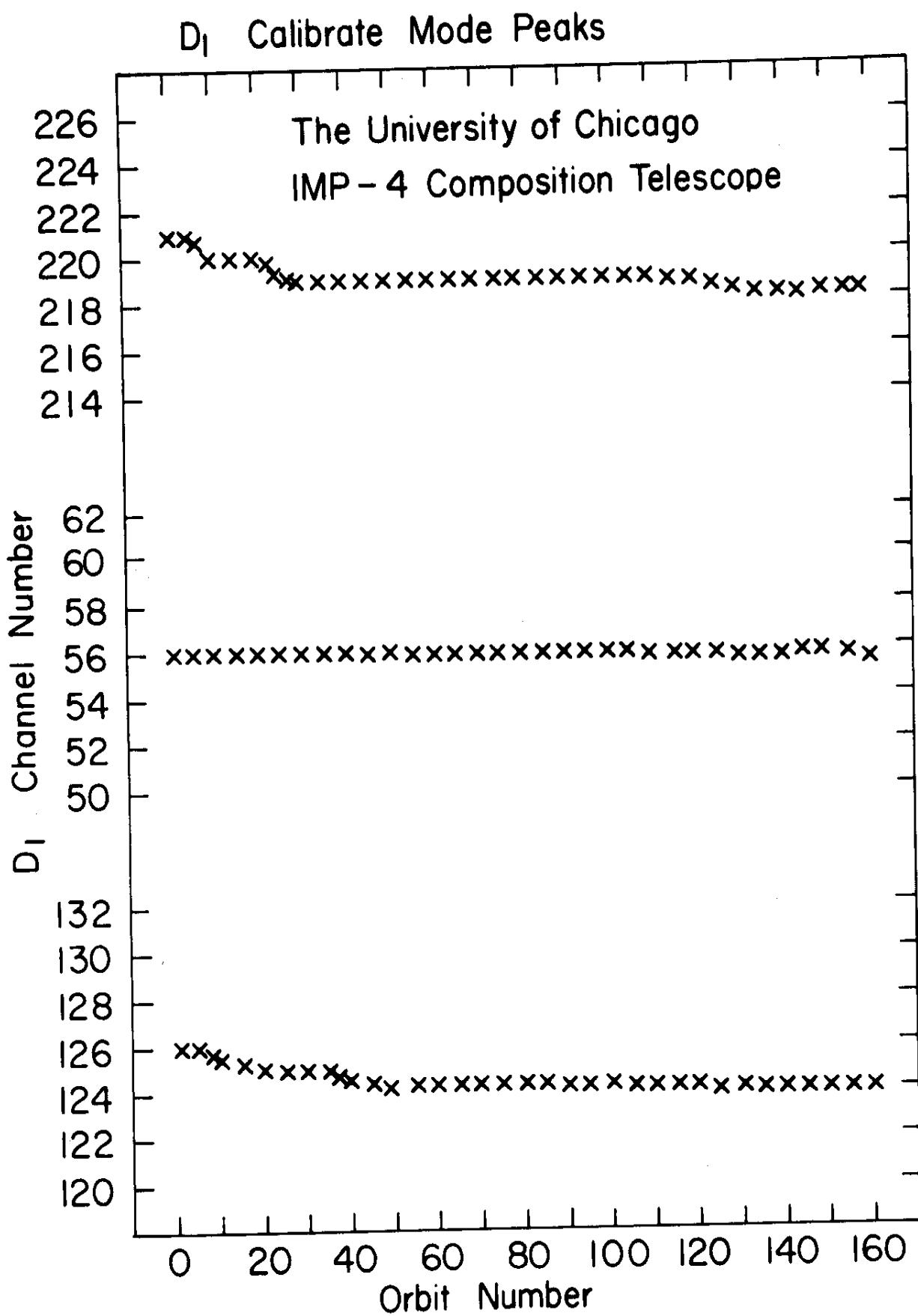


Figure 9a

## D<sub>2</sub> Calibrate Mode Peaks

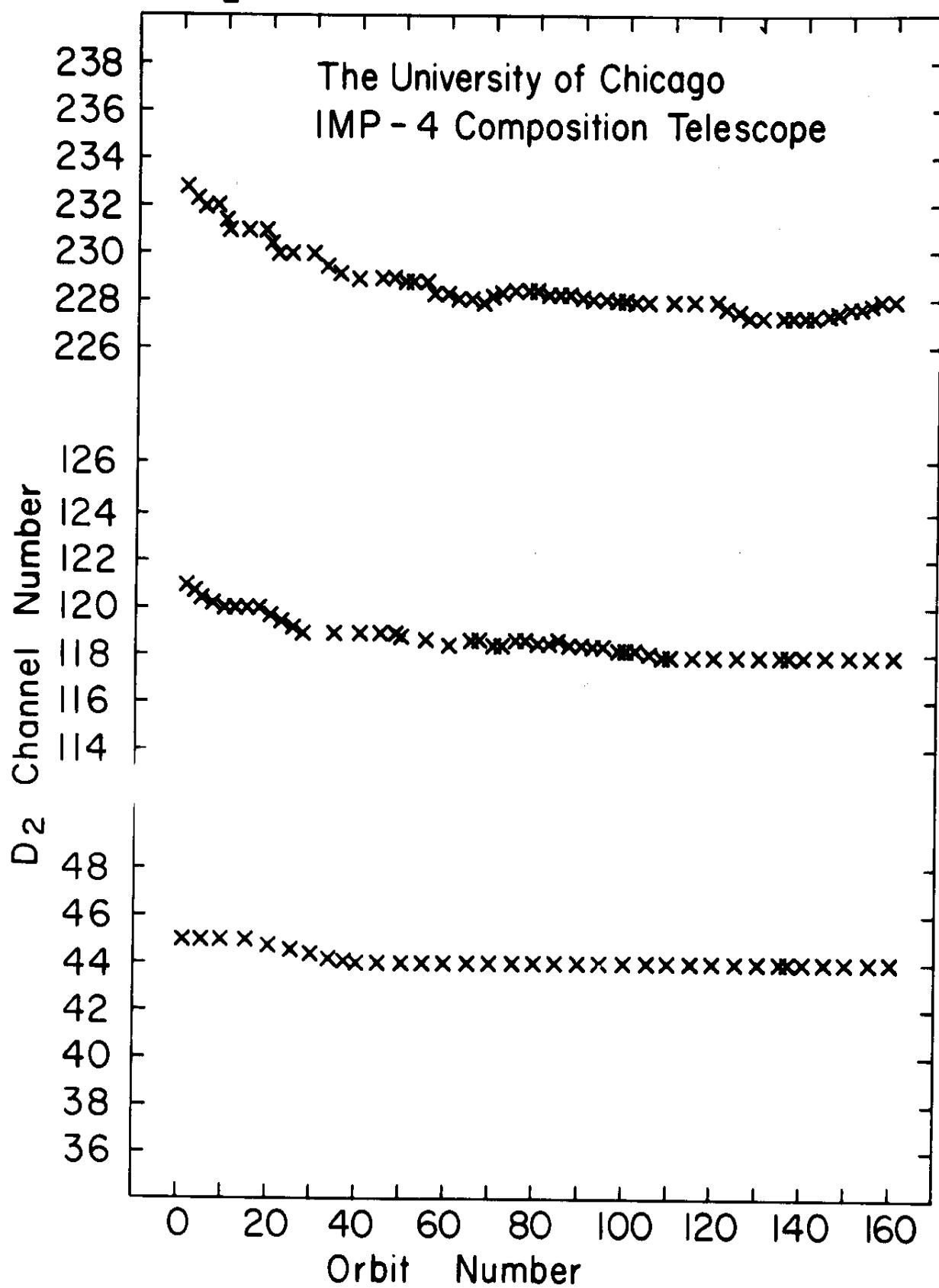


Figure 9b

### D<sub>4</sub> Calibrate Mode Peaks

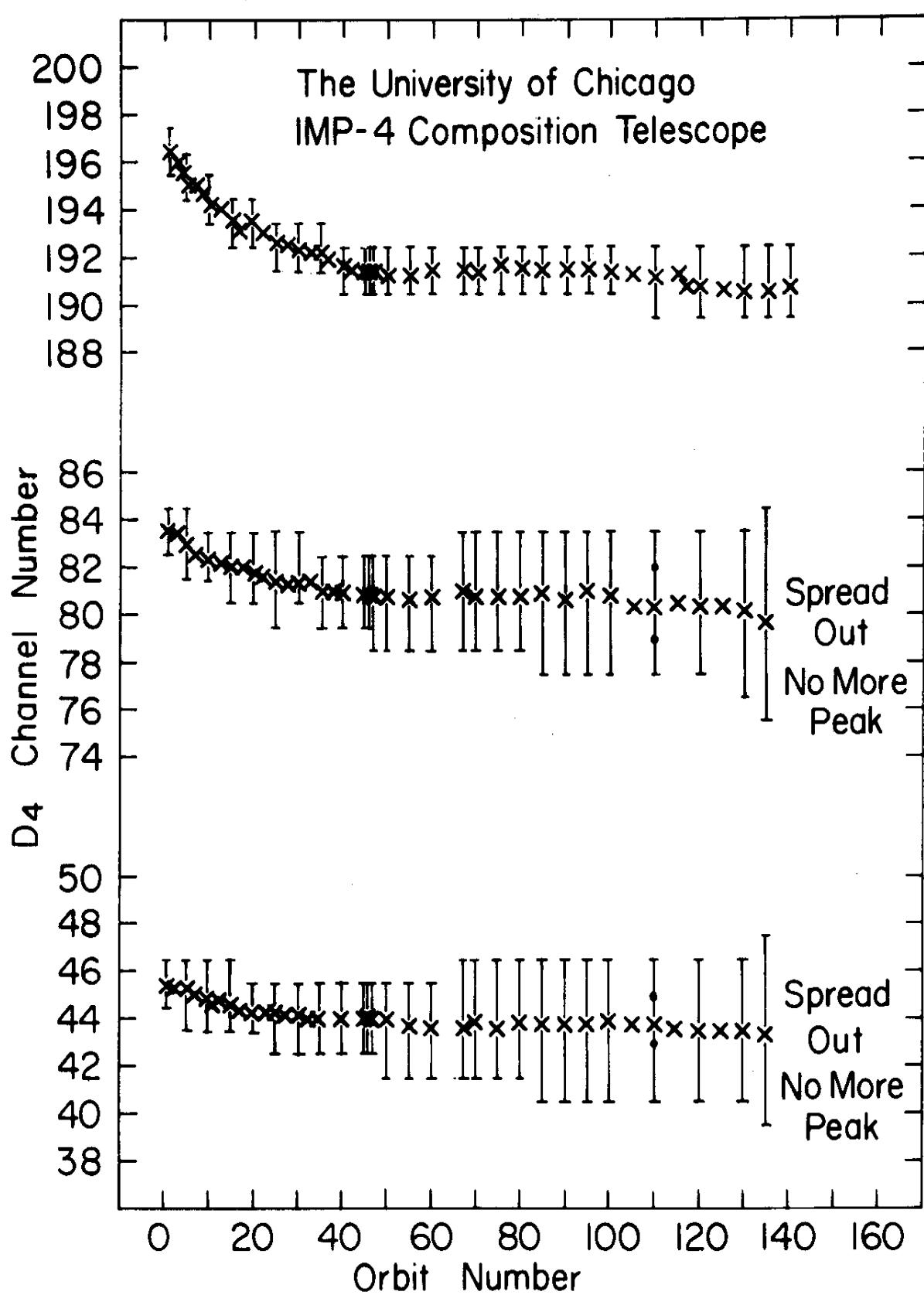


Figure 9c

\*\*\*\*\* (INFILES,MODE,DENSITY,TAPE DESCRIPTION)

30 BIN 800

\*\*\*\*\*

) FILE NO. 1  
116 RECORDS 0 READ ERRORS

47.0 FEET OF TAPE

D-18356

) FILE NO. 2  
118 RECORDS 0 READ ERRORS

47.8 FEET OF TAPE

69-053A-03A

) FILE NO. 3  
121 RECORDS 0 READ ERRORS

49.1 FEET OF TAPE

69-053A-03A

) FILE NO. 4  
119 RECORDS 0 READ ERRORS

48.3 FEET OF TAPE

69-053A-03A

) FILE NO. 5  
124 RECORDS 0 READ ERRORS

50.3 FEET OF TAPE

69-053A-03A

) FILE NO. 6  
112 RECORDS 0 READ ERRORS

45.4 FEET OF TAPE

69-053A-03A

) FILE NO. 7  
119 RECORDS 0 READ ERRORS

48.3 FEET OF TAPE

69-053A-03A

) FILE NO. 8  
123 RECORDS 0 READ ERRORS

49.9 FEET OF TAPE

69-053A-03A

) FILE NO. 9  
119 RECORDS 0 READ ERRORS

48.3 FEET OF TAPE

69-053A-03A

) FILE NO. 10  
123 RECORDS 0 READ ERRORS

49.9 FEET OF TAPE

69-053A-03A

) FILE NO. 11  
129 RECORDS 0 READ ERRORS

52.3 FEET OF TAPE

69-053A-03A

) FILE NO. 12  
126 RECORDS 0 READ ERRORS

51.1 FEET OF TAPE

69-053A-03A

FILE NO. 13  
124 RECORDS 0 READ ERRORS  
50.3 FEET OF TAPE

FILE NO. 14  
117 RECORDS 0 READ ERRORS  
47.4 FEET OF TAPE

FILE NO. 15  
128 RECORDS 0 READ ERRORS  
51.9 FEET OF TAPE

FILE NO. 16  
110 RECORDS 0 READ ERRORS  
44.6 FEET OF TAPE

FILE NO. 17  
119 RECORDS 0 READ ERRORS  
48.3 FEET OF TAPE

FILE NO. 18  
121 RECORDS 0 READ ERRORS  
49.1 FEET OF TAPE

FILE NO. 19  
114 RECORDS 0 READ ERRORS  
46.2 FEET OF TAPE

FILE NO. 20  
114 RECORDS 0 READ ERRORS  
46.2 FEET OF TAPE

FILE NO. 21  
115 RECORDS 0 READ ERRORS  
46.6 FEET OF TAPE

FILE NO. 22  
123 RECORDS 0 READ ERRORS  
49.9 FEET OF TAPE

FILE NO. 23  
124 RECORDS 0 READ ERRORS  
50.3 FEET OF TAPE

FILE NO. 24  
116 RECORDS 0 READ ERRORS  
47.0 FEET OF TAPE

FILE NO. 25  
118 RECORDS 0 READ ERRORS  
47.8 FEET OF TAPE

FILE NO.	26	FILE NO.	27
123 RECORDS	120 RECORDS	120 RECORDS	120 RECORDS
49.9 FEET OF TAPE	48.7 FEET OF TAPE	48.7 FEET OF TAPE	48.7 FEET OF TAPE
0 READ ERRORS	0 READ ERRORS	0 READ ERRORS	0 READ ERRORS

FILE NO. 27	120 RECORDS	0 READ ERRORS
	48.7 FEET OF TAPE	
FILE NO. 28	128 RECORDS	0 READ ERRORS
	51.9 FEET OF TAPE	
FILE NO. 29	122 RECORDS	0 READ ERRORS

FILE NO.	30	NO. OF FILES CHECKED =	30
127 RECORDS		TOTAL NO. OF PHYSICAL RECORDS =	30
51.5 FEET OF TAPE		TOTAL NO. OF READ ERRORS =	0



FILE 0001 REC 0014 CH 4002

FILE 0001 REC 0014 CH 4002

IMP-G

PHA EVENT SUMMARIES (NONOVERLAP)

69-053A-03B

This data set has been restored. There were originally 20 7-track, 800 BPI tapes written in Binary. There are four restored tapes. The DR tapes are 3480 cartridges and the DS tapes are 9-track, 6250 BPI. The original tapes were created on a 930 computer and the restored tapes were created on an IBM 9021 computer. The DR and DS numbers along with the corresponding D numbers are as follows:

DR#	DS#	D#	FILES	TIME SPAN
DR004791	DS004791	D006941 D006940 D006942 D006943 D006944	1 - 20 21 - 40 41 - 60 61 - 80 81 - 100	06/21/69 - 08/27/69 (a) 08/27/69 - 11/02/69 (b) 11/02/69 - 01/09/70 01/09/70 - 03/17/70 03/17/70 - 05/23/70 (c)
DR004792	DS004792	D006945 D011900 D011901	1 - 20 21 - 40 41 - 60	05/23/70 - 07/30/70 07/30/70 - 10/04/70 10/04/70 - 12/10/70
DR004793	DS004793	D011902 D011903 D011904 D011905 D018358	1 - 20 21 - 40 41 - 60 61 - 80 81 - 100	12/11/70 - 02/16/71 02/16/71 - 04/25/71 (d) 04/25/71 - 07/01/71 (e) 07/01/71 - 09/05/71 09/06/71 - 11/12/71
DR004794	DS004794	D018359 D018360 D018361 D018362 D018363 D018364 D018365	1 - 13 14 - 33 34 - 53 54 - 73 74 - 93 94 - 113 114	11/12/71 - 01/18/72 01/18/72 - 03/26/72 03/26/72 - 06/01/72 06/01/72 - 08/07/72 08/07/72 - 10/13/72 10/13/72 - 12/20/72 12/20/72 - 12/23/72

- (a) D006941: Read errors occurred in record 70 of file 1, record 185 of file 2, record 107 of file 18.
- (b) D006940: Read error occurred in record 167 of file 1.
- (c) D006944: Read error occurred in record 57 of file 3.
- (d) D011903: Read errors occurred in record 185 of file 5 & record 124 of file 16.
- (e) D011904: Read errors occurred in record 222 & 225 of file 7.

See 69-053A-03A

IMP-G

5-MIN AVE COUNT RATES (NONOVERLAP)

69-053A-03C

This data set has been restored. There were originally four 7-track, 800 BPI tapes written in Binary. There is one restored tape. The DR tape is a 3480 cartridge and the DS tape is 9-track, 6250 BPI. The original tapes were created on a GE365 computer and the restored tapes were created on a MRS computer. The DR and DS numbers along with the corresponding D numbers are as follows:

DR#	DS#	D#	FILES	TIME SPAN
DR005916	DS005916	D006939	1 - 100	06/12/69 - 05/23/70 (a)
		D011910	101 - 200	05/23/70 - 04/25/71 (b)
		D018366	201 - 293	04/25/71 - 03/26/72
		D018367	294 - 374	03/26/72 - 12/23/72 (c)

- (a) D006939: Read error occurred in record 15 of file 6.
- (b) D011910: Read error occurred in record 14 of file 100.
- (c) D018367: Read error occurred in record 1 of file 81.

See 69-053A-03A

IMP-G

CHICAGO MULTI-COORD EPHEM TAPES

69-053A-00E

This data set has been restored. There were originally 9 7-track, 800 BPI tapes written in Binary. There are two restored tapes. The DR tapes are 3480 cartridges and the DS tapes are 9-track, 6250 BPI. The original tapes were created on a 930 computer and the restored tapes were created on an IBM 9021 computer. The DR and DS numbers along with the corresponding D numbers are as follows:

DR#	DS#	D#	FILES	TIME SPAN
DR004676	DS004676	D006946	1 - 44	06/21/69 - 11/16/69
		D006947	45 - 88	11/16/69 - 04/20/70 (a)
		D006948	89 - 132	04/20/70 - 09/08/70
		D012148	133 - 176	09/08/70 - 02/03/71
DR004677	DS004677	D011931	1 - 44	02/03/71 - 07/01/71 (b)
		D011930	45 - 85	07/01/71 - 11/15/71 (c)
		D018350	86 - 125	12/12/71 - 04/22/72
		D018351	126 - 169	04/22/72 - 09/17/72
		D018352	170 - 198	09/17/72 - 12/23/72

- (a) D006947: Read error occurred in record 97 of file 3.  
(b) D011931: Read error occurred in record 18 of file 1.  
(c) D011930: Read error occurred in record 7 of file 1.

See 69-053A-03A